

## WHAT IS CLAIMED:

1. A method for deriving a process-based specification for a system, comprising:

deriving a trace-based specification from a non-empty set of traces; and

mathematically inferring the process-based specification from the trace-based specification wherein the process-based specification is mathematically equivalent to the trace-based specification.

2. The method of claim 1, wherein the process-based specification is provably equivalent to the trace-based specification.

3. The method of claim 1, further comprising generating the process-based specification using an inference engine.

4. The method of claim 3, wherein laws of concurrency are used by the inference engine to generate the process-based specification.

5. The method of claim 4, wherein the laws of concurrency are reversed by embedding the laws of concurrency in the inference engine.

6. The method of claim 5, wherein the embedding is syntactic or shallow.

7. The method of claim 5, wherein the embedding is semantic or deep.

8. The method of claim 4, wherein the laws of concurrency are reversed so that an equivalent process expression is output in response to a given input of at least one trace.
9. The method of claim 8, wherein multiple process expressions are given as output in response to inputs of the at least one trace.
10. The method of claim 1, further comprising analyzing the process-based specification to examine possible implementations of the process-based specification in different configurations.
11. The method of claim 10, wherein the various possible implementations of the process-based specification are based on transformations of the process-based specification by application to laws of concurrency to derive various implementations.
12. The method of claim 11, wherein the various equivalent implementations are mathematically equivalent to the process-based specification.
13. The method of claim 12, wherein the various equivalent implementations are provable equivalent to the process-based specification.
14. The method of claim 13, wherein multiple correct process-based specifications are possible.

15. The method of claim 14, further comprising deciding which of the multiple correct process-based specifications are most appropriate.

16. The method of claim 15, wherein the process-based specification is used as a basis for generation of alternate representations.

17. The method of claim 16, wherein the alternate representations are sets of instructions.

18. The method of claim 1, wherein the set of traces is a set of sequences of events or activities specific to an application domain.

19. The method of claim 1, wherein the set of traces is derived by pre-processing a set of scenarios given as input by a user to a context sensitive editor.

20. The method of claim 19, wherein the set of scenarios is natural language text describing intended system behavior, and the elements of the set of traces are sequences of events or activities in a given application domain.

21. The method of claim 20, wherein the set of scenarios is represented by various graphical notations.

22. The method of claim 1, wherein the deriving step is repeated.

23. The method of claim 1, wherein the inferring step is repeated.

24. The method of claim 1, further comprising reverse engineering an existing system using the deriving step and the inferring step.

25. The method of claim 1, further comprising reverse engineering an existing system back to a set of traces using the deriving step and the inferring step.

26. A system for deriving a process-based specification for use in a system, comprising:

- at least one natural language scenario;

- a trace-based specification derived from the at least one natural language scenario; and

- an inference engine to mathematically infer the process-based specification from the trace-based specification such that the process-based specification is mathematically equivalent to the trace-based specification.

27. A system for deriving a process-based specification for use in a system, comprising:

- a non-empty set of traces;

- a trace-based specification derived from the set of traces;

- an inference engine to mathematically infer the process-based specification from the trace-based specification such that the process-based specification is mathematically equivalent to the trace-based specification.

28. A method for deriving a process-based specification for a system, wherein the system performs actions, comprising:

receiving at least one natural language scenario describing the actions;

generating a trace-based specification from the at least one natural language scenario;

mathematically inferring the process-based specification from the trace-based specification, wherein the process-based specification is mathematically equivalent to the actions defined above.